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INSULATED X-RAY CABLES

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FIG. 1.

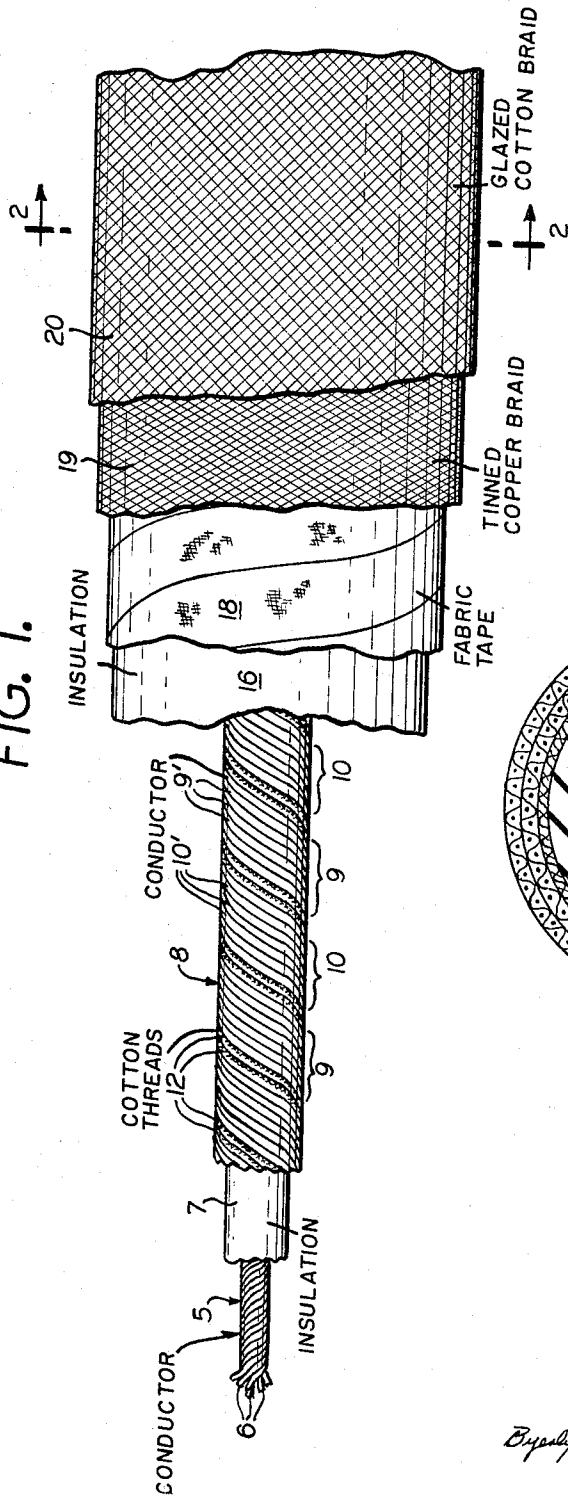
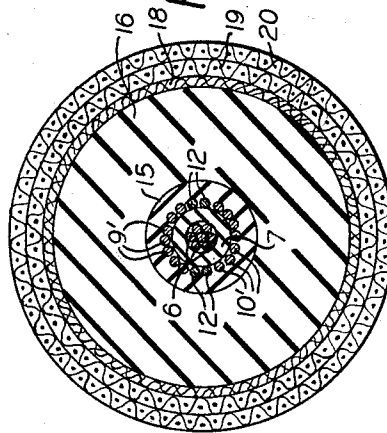


FIG. 2.



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INSULATED X-RAY CABLES

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4 Claims. (Cl. 174-105)

This application is a continuation-in-part of application Serial No. 117,148, filed June 14, 1961, and now abandoned.

This invention relates to electrical conductors and aims to provide an improved insulated cable.

It is a particular object of my invention to provide an insulated cable that is adapted for use in connecting equipment such as X-ray apparatus with the electric power source therefor. Cables of that type include a plurality of insulated electrical conductors, each of which must be capable of conducting electricity of high voltage with respect to ground although the voltage differentials in the respective conductors of the cable are ordinarily quite low. Thus, in a three-conductor X-ray cable for instance, each of the conductors may be required to conduct peak voltages with respect to ground of the order of 75 kilovolts or above, whereas the voltage differences in the respective conductors of the cable may be of the low order of about 40 volts. The consequence is that, while the respective conductors of an X-ray cable may be lightly insulated with respect to each other, it is necessary that they be heavily insulated with respect to ground. It is a further requisite of X-ray cable that it be very flexible in order that the operator of the X-ray equipment to which it is connected be able to move such equipment without excessive effort, and the equipment must remain in the position in which it is placed by the operator without liability of displacement because the cable to which it is connected is excessively stiff and inflexible.

Past X-ray cables which have included three separate conductors, for instance, have been made by covering each member of a pair of those conductors with insulation. Those insulated conductors were twisted about each other and then the third conductor was wrapped around the twisted insulated pair. This assembly was then provided with a heavy layer of insulation which in turn was covered with a coating that included a conductive shield. In such cables the assembled conductors to be insulated are so thick and the quantity of insulation that is required therefor is so great that the cable is large and lacking in the flexibility needed for the ready bending of the cable that will permit easy manipulation of the apparatus with which it is connected.

I have discovered that it is possible to overcome the foregoing disadvantages of past X-ray type cables having a plurality of conductors (e.g., three or more) by covering only one of said conductors with an individual layer of a good insulating material. This may be accomplished by known extrusion practices. That insulated conductor is then used as a central support around which is wrapped a substantially flat serving including the balance of the conductors of the cable and which are formed in adjacent groups of parallel, contiguous strands of a metal that is a good conductor. The serving also includes an insulating material such as cotton thread separating the adjacent strands of the respective groups of contiguous metal strands from each other. The main body of insulation for the cable is thereafter provided by a thick body of a material which is a good insulator that may be placed over the serving-covered core through extrusion; and this in turn is given a conventional type of shielded coating.

An insulated X-ray cable embodying my invention comprises a central core of metal of high conductivity, a thin

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layer of insulation surrounding that central core, and a substantially flat serving surrounding that layer of insulation. The conducting core is preferably formed of a number of strands of the metal, twisted around each other. The flat serving includes groups of parallel, contiguous strands of metal of high conductivity and insulating thread which separates the respective groups of contiguous strands from each other. A thick layer of insulation surrounds the serving and is provided with a covering.

In the case of X-ray cable designed and adapted to conduct current of peak voltage with respect to ground of the order of 75 kilovolts, for instance, cable constructed in accordance with my invention may have an outside diameter 20-30% less than the outside diameter of conventional cable for the same current load. My thinner cable is, as a consequence, much more flexible than conventional cable and it can be made at a significantly lower material cost. The resistance between the respective groups of contiguous strands of metal in the flat serving can be increased and rendered more uniform, if desired, through the application, to the outer surface of that serving, of a light layer of an amorphous insulating wax.

The specific embodiment of my invention in the form which I now prefer is illustrated in the accompanying drawings in which:

FIG. 1 is a length of my new cable, exaggerated in size for purpose of illustration, with the respective layers broken away in part; and

FIG. 2 is a section along the lines 2-2 of FIG. 1.

The cable illustrated in the drawing comprises a central core 5 formed from a number of twisted strands 6 of a metal of high conductivity such as copper. A thin layer 7 of insulation covers the central core 5. The layer 7 is composed of a material which is a good insulator, with which the central core 5 can be coated by known extrusion practice. The insulating material forming the layer 7 is preferably a flexible material such as a natural or synthetic rubber although, where flexibility is not the primary consideration, a plastic such as an insulation grade of polyethylene may be used. Wound around the layer 7 of insulation is a serving indicated generally at 8. The serving 8 illustrated in FIG. 1 includes a pair of conductors 9, 10 composed respectively, of parallel strands 9', 10' of a metal of high conductivity such as copper. Outermost strands 9' of the conductor 9 are separated from the outermost strands 10' of the adjacent conductor 10 by cotton threads 12.

After the serving 8 is wound around the layer 7 of insulation, it is preferably coated with a light layer 15 of an amorphous insulating wax, and this, in turn, is covered by a thick body of a material which is a good insulator. The serving can be coated with a light layer of wax by drawing the core 5 to which that serving has been applied through a bath of molten wax. To permit this, the wax that I prefer to employ in the practice of my invention has a melting point of about 149-150° C. After the serving 8 is coated with a light layer of wax, the thick body of insulation 16 can be applied through extrusion. The thick body of insulation 16, like the layer 7, is preferably a flexible material such as a natural or synthetic rubber and, desirably, one which is sufficiently fluid when applied to ensure good physical contact with the entire surface of serving 8, filling any spaces that may exist therein. However, a somewhat stiffer plastic material such as an insulation grade of polyethylene may, on occasion, be used for this insulation also.

The insulated cable that I have described can be given a conventional covering including fabric tape 18, tinned copper braid 19 and glazed cotton braid 20.

The terms that I have used in describing the illustrative embodiment of my invention shown in the drawing are

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terms of description and not of limitation. It will be appreciated that various modifications can be made in that specific embodiment of my invention without departing from the spirit of my invention as it is defined in the appended claims. For instance, while I prefer to make the main body of insulation of the two layers 15 and 16 such as I have described, it is possible to employ with advantage over my serving a single layer of insulation provided its properties and thickness are such as to afford the protection required of it. Also, it is possible in the practice of my invention to associate with each of the conductors 9, 10, an index such as a distinctively colored tracer thread (not shown); and the number of strands 9' or 10' contained in those respective conductors can be varied in accordance with the current loads such conductors are designed to carry.

What I claim is:

1. A flexible insulated high voltage X-ray cable comprising a central core of metal of high conductivity, a thin layer of insulation surrounding said core, a substantially flat serving on said layer of insulation including groups of parallel, contiguous strands of metal of high conductivity and insulating thread separating the respective groups of contiguous strands from each other, a thick layer of insulation surrounding said serving, and a covering for said thick layer of insulation.

2. An insulated X-ray cable comprising a central core of metal of high conductivity, a thin layer of insulation surrounding said core, a substantially flat serving on said layer of insulation including groups of parallel, contiguous strands of metal of high conductivity and cotton thread separating the respective groups of contiguous strands from each other, a thick layer of insulation surrounding said serving, and a covering for said thick layer of insulation.

3. An insulated high voltage X-ray cable comprising

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a central core of metal of high conductivity, a thin layer of insulation surrounding said core, a substantially flat serving on said layer of insulation including groups of parallel, contiguous strands of metal of high conductivity and insulating thread separating the respective groups of contiguous strands from each other, a thick layer of insulation surrounding said serving, and a covering for said thick layer of insulation including a shield of metal of high conductivity.

4. A flexible insulated high voltage X-ray cable comprising a central core of metal of high conductivity, a thin layer of insulation surrounding said core, a substantially flat serving on said layer of insulation including groups of parallel, contiguous strands of metal of high conductivity and insulating thread separating the respective groups of contiguous strands from each other, a light layer of amorphous insulating wax coating said serving, a thick layer of insulation surrounding said coated serving, and a covering for said thick layer of insulation.

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